PHIN (John.)

TRICHINÆ

(PORK WORMS, OR FLESH WORMS).

HOW TO DETECT THEM;

AND

HOW TO AVOID THEM.

BEING

A POPULAR ACCOUNT OF THEIR HABITS, MODES OF PROPAGATION, AND MEANS OF DISSEMINATION.

INTENDED FOR THE USE OF

FARMERS, BUTCHERS, PORK DEALERS, AND CONSUMERS OF PORK.

BY JOHN PHIN,

EDITOR OF THE "AMERICAN JOURNAL OF MICROSCOPY."

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TRICHINA SPIRALIS.

(Pork-worm or Flesh-worm.)

THERE is probably no country in which the Pig serves a more important purpose than in the United States. The ease with which the animal is raised; the facility which it affords for converting corn, clover, and similar bulky articles into a concentrated form of food, and the ease with which its flesh is cured for storage and transportation, all combine to render it a source of immense income to the country. Consequently, anything which tends to injure it as a food product, lessens the amount produced, interferes with the market for it, and thus becomes a great national evil, as well as a source of disease and death to thousands.

That the *Trichina spiralis*, or, as it is sometimes called, the "pork worm" or "flesh worm," *does* decrease the market value of the "hog crop," is a fact too well known to require elaborate proof at our hands. Of the many undoubted cases of trichinosis which have occurred in this country, several have been caused by native pork, and the elaborate investigations of Dr. Belfield and Mr. Attwood showed that during a certain period the astonishing amount of 8 per cent. of the hogs slaughtered in Chicago were infested with this parasite! And so deeply has this been impressed upon foreign governments, that in many European countries the importation of American pork is permitted only under the most stringent regulations. These facts show the importance of a general diffusion of information in regard to the best means that have been discovered for detecting this pest where it exists, and of avoiding its effects, as well as of preventing its increase, if not of stamping it out altogether. To do this, however, it will be necessary, first of all, to give a brief account of what is called the "life history" of the parasite—that is to say, of its changes and modes of growth, from its first appearance as an embryo, to the death which overtakes it when it has finished its career according to natural laws.

LIFE HISTORY OF THE TRICHINA.

In the case of most animals, we trace the individual from its birth upwards, but we shall find it more convenient to begin the history of the trichina with the closing period of the life of its parents.

If we find a piece of meat which has caused death, or even serious sickness in those who have eaten of it, we may possibly find, if this sickness is due to trichinæ, that a slice of it, when cut lengthwise of the fibres, has a specked appearance even to the naked eye. Such appearance is well represented in Figure 1, taken from Harley's "Histological Demonstrations."

In this case the trichinæ have been in the flesh for some time, and have become surrounded with hardened (calcified) capsules, or coatings, which render their presence and position visible. But if it had happened that the animal from which the meat was taken had become infected but a short time before being butchered, the capsules, or "cysts," as they are called, would have been transparent, and the parasites invisible to the naked eye. To detect them under such conditions we must cut a very thin slice, so thin as to be transparent; this slice, or, as microscopists call it, "section," must be placed between two pieces of glass, and moistened with water, glycerine, or, better still, acetic acid. The plates of glass are then squeezed together, and when the piece of meat has become so thin that it is quite transparent, it may be viewed by means of a strong magnifier, by holding it up to the light and looking through it. Ordinary pocket magnifiers are not quite strong enough; one magnifying at least 25 diameters should be used, and then, if trichinæ are present, the flesh will present the appearance shown in Fig. 2, which has been accurately drawn from a piece of trichinous flesh seen under a common lens.

Fig. 1.

Such a magnifying power, although abundantly strong enough for the *detection* of trichinæ, is not always quite sufficient to enable us to make a satisfactory examination of the worms themselves, but this is a matter of no consequence, so far as the ordinary requirements

of practice are concerned. But with a good clear lens, even this power enables us to distinguish the coiled-up form of the worm,

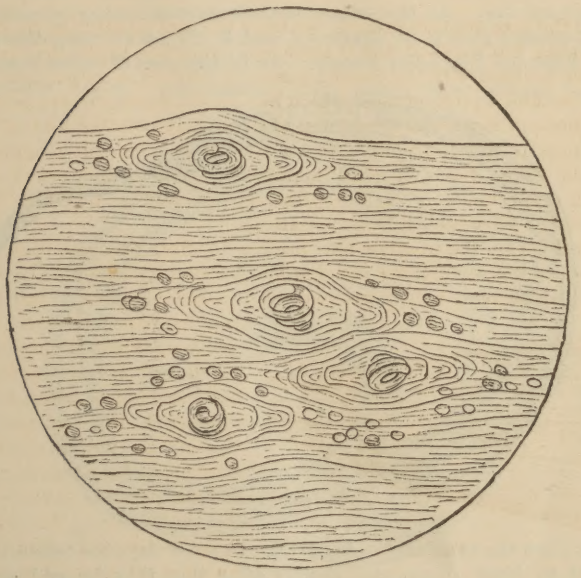

Fig. 2.

from which they derive their specific name *spiralis*. Let us now follow the changes which take place when such a piece of meat is eaten. As seen in the flesh shown in Figure 2, the living worms are enclosed in bags or cysts, one of which is shown more highly magnified in Fig. 3. In time these cysts become coated with a calcareous deposit, so that the worms are literally entombed in marble coffins. At first this probably serves to protect them. Worms in this condition, therefore, are incapable of doing further harm; their career of mischief, so far as they themselves are concerned, is ended. But when the flesh in which they are embedded is eaten and digested, the capsules are dissolved, and the worms are set free to move about in the stomach

Fig. 3.

and intestines like so many diminutive eels. They now increase in size, and another and far more important change takes place. The males and females become mature sexually, and unite to perpetuate their species. At this stage of their existence they present the appearance shown in Figures 4 and 5, Fig. 4 showing the male trichina and Fig. 5 the female. As in the case of other worms of

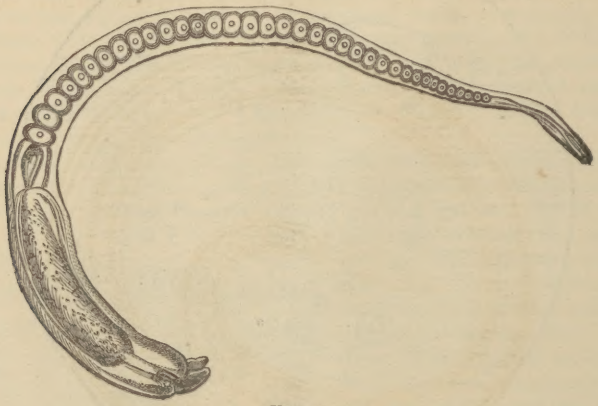

Fig. 4.

this class the small end is the head. In a few days the females give birth to living young, and shortly after that they die and are expelled with the refuse food. Each female produces a number of young, which has been variously estimated at from two thousand to twenty thousand. Leuckart, one of the very highest authorities, says not less than from ten to fifteen thousand. The young are born alive, and it is these embryos which cause the disease known as *trichinosis* or *trichiniasis*.

As soon as they are born, they proceed at once to bore through the walls of the intestines, and enter the muscles. Through the connective tissue of the muscles they mine their way, absorbing the juices of the flesh, and growing larger and larger, until their progress is arrested, either by their inability to bore through the tendons, or by the fact that they have reached their full size and it is time for them to curl up and go to rest. When this period arrives, the worm coils itself, as shown in Fig. 3, and a cyst or bag is formed around it. At first this cyst is perfectly transparent, but

after a time a deposition of calcareous matter takes place, and it presents a whitish appearance, which renders it visible to the naked eye, as shown in Fig. 1.

Once safely enclosed within its cyst or capsule, the trichina is powerless for mischief. It does not multiply; it does not consume the substance of the muscle in which it is imbedded, and the unconscious "host"* may harbor it for many years without being

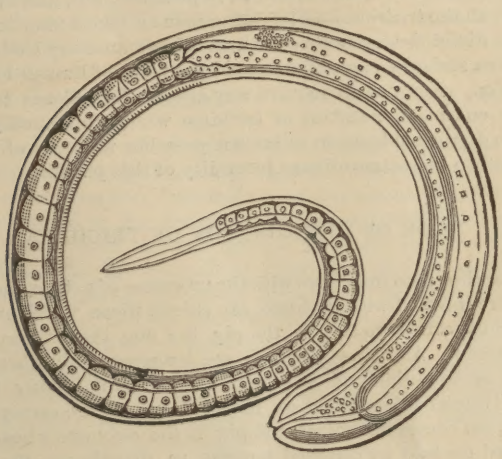

Fig. 5.

aware of the fact. The life history of the trichina is thus contained in a cycle which includes at least two animals—the first being that in which the parasite is born, partially matured, and then enclosed in a living tomb, and the second that in which it is set free, and in which it becomes fully mature, propagates its species, and dies.

Such being the life history of the trichinæ, we are now prepared to consider their origin and the modes of their distribution, together with the most effective methods of avoiding and destroying them.

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*In the language of writers on this subject, the "host" or "bearer" is the animal (human or other) that harbors the parasite. The parasite is called a "guest" when it lives at the expense of the host, and a "messmate" when it merely shares its dwelling without devouring its substance.

OF THE ORIGIN OF TRICHINÆ.

There has been a great deal of speculation in regard to the *origin* of the trichina, but, as was to have been expected, with very unsatisfactory results. We know just as much of the *origin* of trichinæ as we do of the origin of the pig, the cow, or the goat, and *no more*. That they may change their habits and some of their characteristics when placed under new conditions is possible; but, like every other animal, all the trichinæ now infesting man and the domestic animals, are the direct descendants of others whose ancestry leads back in unbroken series to a point far beyond the reach of human knowledge or reason. Nor does it require any special hypothesis to account for the enormous numbers of trichinæ which confessedly exist, if we give due consideration to known possible methods of distribution, and to the extraordinary fecundity of this parasite.

MODE OF DISTRIBUTION OF TRICHINÆ.

Unless when man interferes with the processes of nature, the animals which are infested with trichinæ, are chiefly those which are wholly or partially carnivorous, like the pig, the dog, the cat, the rat, and man himself. And since trichinæ are dangerous only when present in any given animal in very large numbers, it is only the flesh of carnivorous animals that we have to fear. Of the carnivora with which man comes in contact, the pig is the only one whose flesh is employed for food by civilized nations, so that the rat, the cat, and the dog, must be left out of the *direct* sources of human trichinosis, although as propagators and distributors of the pest, they cannot be safely neglected.

It would seem that some animals, even when exposed to infection, do not readily harbor those objectionable guests; thus, even when birds and sheep have been liberally fed with trichinous meat, these parasites cannot be detected in their flesh. But, in the ox, the rabbit, and the guinea pig, they multiply freely, and become encysted in the flesh of these animals, ready, under suitable conditions, to again begin the cycle of their life history. Fortunately, however, the sources from which oxen and other strictly herbivorous animals obtain trichinæ are so limited that but little danger ever arises to humanity directly from this source, and it is only when other agencies come into play that the flesh of the ox demands our attention in this regard. To understand these con-

ditions, it is necessary to examine the means by which trichinæ are transferred from one animal to another. These are:

1. *By eating trichinous meat.*

This is by far the most common method, and is, undoubtedly, the way in which pigs and rats generally become infected. And as it happens that the parts which are generally thrown aside as offal (the diaphragm, the head, and the parts at which muscles and tendons join), are those which are specially liable to contain trichinæ, it follows that the pigs which are reared on offal, and the rats which infect slaughter houses, are very liable to contain trichinæ.

2. *By eating the excrements of animals that have recently been infected with trichinæ.*

The dog, the pig and the rat are all ravenously fond of excrementitious matter—eating it greedily, when they can get at it. Now, when an animal has recently had a dose of trichinous flesh, there will always be found in the fæces, not only young trichinæ, but mature females which have not yet got rid of their burden of young. When taken into the stomach of another animal, these young trichinæ develop and bore their way through the intestines and muscles of their new host, and the females complete their functions in their new abode. Hence it is a well-known fact that one trichinous hog will infect a whole herd, and it was, doubtless, from the excrements of rats, mingled with its food and water, that the hippopotamus in the Zoological Gardens of London, obtained the trichinæ which were found to infest its muscles.

3. *By drinking water in which trichinous flesh has putrefied or decomposed.*

One of the most remakable characteristics of the trichina is its power to resist the action of agents, which are destructive to most other animals. The gastric juices of the stomach, the influence of putrefaction, and even soaking in strong chemicals, such as chloride of zinc, all fail to destroy it. The Vienna Committee reported that "after remaining for months in putrefied flesh, they (trichinæ) did not lose their vitality." And Goujon succeeded in infecting with trichinous meat 80 to 100 days after it became putrid. The obvious result of this is that if a trichinous rat, cat, dog, or pig should die by the side of a stream, or be drowned in it, and the flesh should putrefy, any animal that drinks of the water in the immediate neighborhood may pick up quite a number of trichinæ, and these, when introduced into the stomach, will soon be multiplied by thousands. In this way oxen and horses, though strictly herbi-

vorous, may, under perfectly natural conditions, become infected with trichinæ.

4. *By eating vegetables (grass, clover, lettuce, cabbage, celery, etc.), which have been manured with the offal or excremeats of trichinous animals.*

We have already stated that the excrements of animals recently infected with trichinæ, contain large numbers of these pests. And since the trichinæ are not destroyed by the putrefaction of the flesh in which they are found, plants manured with trichinous offal may very readily communicate trichinæ to herbivorous animals, or even to man himself.

Some of these sources of infection would seem at first sight to be very trivial—indeed, scarcely worthy of consideration, in view of the fact, previously stated, that it is only when present in large numbers (many millions), that trichinæ are dangerous. In arriving at such a conclusion, however, we leave out of consideration the cumulative character of this parasite.

This feature has not hitherto received the consideration which we think its importance demands. We can all understand how a pig, after eating a pound or so of the offal of a trichinous pig, should became dangerous to any human beings that might eat its flesh without having it first thoroughly cooked, but we do not as readily realize that successive minute doses of strongly trichinous flesh, or larger quantities of flesh that is very slightly infected with trichinæ, may, after a time, bring a pig into a condition quite as dangerous as that of the first. This arises from the fact that trichinæ which have once become encysted or encapsuled in the muscles, may remain there living and ready for the next stage of their life history for long periods—some say as much as ten to twenty years. The progeny of each successive dose are, therefore, added to those that precede them, and the accumulation may, in time become quite formidable. For example, a pig that is fed on slaughter house offal, will, in all probability, occasionally eat some flesh containing trichinæ. Each dose may be too small to affect the animal to such an extent as to produce evident sickness, and yet may add a hundred thousand or so of encysted trichinæ to its muscles. After a few repetitions of this operation the flesh of the animal will become so full of the parasite as to cause severe disease or even death in those that consume it, while at the same time the animal has all the time maintained a fair degree of health.

In the case of pigs, which are generally killed while comparatively young, this may not be such an efficient cause, but in the case of a rat, which may inhabit a slaughter house for many years, and ulti-

mately fall a prey to some ravenous porker, there can be no doubt that it plays a most important part. And, as from the comparatively small size of the rat, the animal is almost always entirely consumed by the pig that happens to catch it, it acts as a concentrator as well as a gatherer.

It is chiefly from this point of view that the omnivorous rat becomes such a dangerous trichina gatherer, especially when associated with the equally omnivorous pig.

That pigs catch, kill and eat rats, has been denied, but only by those who are ignorant of the habits of the hog.

One author says that he does not believe that pigs are sufficiently active to catch a rat*, but it is well known to farmers that pigs which are not very fat, such as brood sows and those that are kept over from one season to another, frequently capture these vermin. Nor is it necessary to this theory that the pig should be able to catch the living rat. Almost every butcher and drover has one or more dogs; these animals enjoy no fun better than that of killing rats, but they never eat them.† The rats, if killed in or near a pig pen, are left for the pigs who soon make away with them.

Moreover, when turned into the fields and forests, the pig is a most assiduous hunter of rats, mice, and such like vermin, which he roots out of their underground nests and eagerly devours. Of this we ourselves have had ocular proof; and as these animals are known to be migratory, it is easy to suppose that rats, which have become infected in slaughter houses and elsewhere, may be thus caught and eaten by pigs. And it is most probably in this way that the wild swine of the European forests obtained the trichinæ which have been found in them. The same is also the way in which the wild boar, whose flesh recently occasioned an epidemic of trichinosis in the village of Khiam, near the sources of the Jordan, obtained its trichinæ.‡

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* We have it on good authority that the horse has been known to kill with his teeth the rats that annoyed him in the manger. Of course he did not *eat* them.

† It is a curious fact that dogs are not so liable to harbor trichinæ as cats. We have frequently found trichinæ in cats, but never in dogs, although it might be supposed that the dog, feeding more than the cat upon butcher's offal, would be more liable to pick up trichinæ. We believe that the cause of this lies in the fact that cats eat rats, while dogs never eat them. Dr. Seiler informs us that almost all the cats that he has examined in Philadelphia, have been infected with trichinæ.

‡For full account of this outbreak see *London Lancet* for May, 1881. (American Edition.)

These facts, combined with the extraordinary fecundity of the trichinæ themselves, readily explain the occurrence of epidemics of trichiniasis. Indeed, when we consider the very small number of encysted trichinæ, which, after passing through two or three animals, may give rise to a brood of many millions of embryos, the wonder is that, under our present system, trichinosis is not a more common disease than it is.

Let us suppose that a rat, feeding on the offal of a slaughter house, picks up two dozen trichinæ in a piece of meat—a very small number. Cobbold, one of the most thorough and careful authorities, in his calculations, claims for each trichina an average progeny of about 3,000.* We will take, therefore, half this number, and assume that after the regular time our rat has 36,000 encysted trichinæ in its muscles. If, now, this rat be eaten by a pig, the latter animal will become the host of 54,000,000 trichinæ, and its flesh, in quantities of half a pound or so, would be fatal to any human being that might eat it without having it properly cooked.

DESTRUCTION OF TRICHINÆ.

We have already stated that the trichina is exceedingly tenacious of life, resisting the effect of powerful chemical agents, and the destroying influence of putrefaction in the meat in which it is embedded. Cobbold fed a dog with a small piece of trichinous human flesh which had been saturated with a solution of chloride of zinc, and afterwards, on killing the animal, he found it infested with trichinæ. Indeed, the trichinæ were seen to be alive in the flesh before it was fed to the dog. Ordinary salting and smoking do not destroy this parasite, though long-continued exposure to smoke does kill them. It has been found that some chemical agents cause their speedy death, but we do not regard such methods of destruction as of any great value.

Fortunately, we have, in the simple process of *thorough* cooking, a perfectly efficient means of killing trichinæ and all other parasites. But in order to be effectual, the cooking must be *thorough;* no mere surface scorching on the one hand, or brief dipping in boiling water on the other. It has long been known that a lump of flesh, placed in boiling water, may be very thoroughly cooked on the outside, while the interior has not reached a temperature high enough to

*This estimate makes allowance for the fact that half of the trichinæ are males, and also for the loss incurred by the expulsion of embryos and mature females with the fæces.

destroy any parasites that may be present. Prof. Perroncito, of Turin, has shown that when trichinæ are exposed to a temperature of 50° C. (122° Fahr.) for five minutes, they are killed. Leuckart, however, claims that a temperature of 65° to 70° C. (149° to 158° Fahr.) is necessary to destroy them. A most interesting and important fact, however, is that large masses of meat may be brought to the temperature of boiling water at the surface, and yet remain at a comparatively low heat in the interior. Thus Prof. Perroncito found that a ham, weighing 12 lbs., put into cold water, and heated, had attained only 25° C. (77° Fahr.) at the centre, when the surrounding water had reached the boiling point. And even after thirty minutes the thermometer indicated at different parts of the interior only 35° and 40° C. (95° to 104° Fahr.)—a temperature far below the death point of trichinæ in the state in which they are usually found in flesh. Larger hams, as might have been expected, showed still more marked results.

Great care must therefore be taken to secure *thorough* cooking, but if this be done no fear need be entertained in regard to trichina, no matter how many of these parasites may be present in the meat.

But it is not enough that we should be able to protect *ourselves* from occasional exposure to these pests; the interests of our commerce, of our agriculture, and the health of our domestic animals, all demand our most serious efforts to stamp out this enemy. How shall this be accomplished?

It is probable that there are modes of propagation and distribution of which we are still ignorant, but we feel tolerably certain that the four modes which we have already described are those by which almost all the mischief is done. And if it were not for the rat, trichina could be easily stamped out of the country in a few years. As it is, however, much may be done towards getting rid of this pest, even in the presence of rats, but to accomplish this, certain practices, at present in vogue, must be abandoned. And so important do we regard this battle against what Dr. Kratz calls "man's most dangerous enemy," that the most stringent legislation should be adopted on the subject. This legislation should look to the prevention and destruction of trichinæ, rather than to the mere detection of these pests, and the confiscation of the meat containing them. The appointment of thousands of meat inspectors will do no good unless the sources of the trichinæ are removed. Therefore, let sufficient regulations be enforced, and cause every butcher to become his own inspector by imposing severe penalties upon the man that offers trichinous meat for sale.

As at present conducted, the small, private slaughter houses which abound in this country could not be more effectively arranged and managed if the propagation of trichinæ were their chief object. The offal is used for feeding pigs and for top-dressing land, and the omnipresent rat is always on hand to contribute his share to the general evil—liberal arrangements being made for his maintainence, and for furnishing him with a proper supply of parasites. All this must be reformed, and the commission of the following acts should be declared to be a penal offence, punishable by fine, and, on a second offence, by imprisonment:

1. Feeding pigs on raw offal of any kind. All flesh and animal matter fed to pigs must be chopped into pieces not larger than a cubic inch, and thoroughly cooked. This would not only destroy the parasites, but so improve the food that the extra expense would be more than made up.

2. Manuring with slaughter-house manure or offal, grass lands or land on which is grown vegetables that are to be eaten in a raw state by man or beast.

This, of course, still leaves the rat as a free rover to pick up trichina where he can, and in turn yield them to the pig. To destroy all the rats, or even to keep them away from our slaughter houses and pig pens, would manifestly be impossible. The only way to prevent them from being propagators of trichina is to remove all uncooked offal from their reach. All offal should therefore be either at once thoroughly cooked or destroyed, and if this is not done immediately, it should be securely kept in places lined with sheet iron.

DETECTION OF TRICHINÆ.

The following directions have not been written for the use of experts or professional microscopists. We therefore describe the simplest methods capable of securing trustworthy results.

The microscope affords the only reliable means of detecting trichinæ, and fortunately its employment is by no means difficult. Any good microscope will answer, care being taken to employ low powers. When high magnifying powers are used, it requires great skill to find and show these parasites. With the ordinary compound microscope, the one inch or two-inch objective gives power enough; where a simple microscope is used, one magnifying not less than 25 diameters should be selected.

The first thing that the beginner should do is to familiarize him-

self with the appearance of the worm as it is found in flesh. To this end it is well to procure a specimen properly mounted as a microscopic object. Such specimens may be procured at a very trifling cost from almost any dealer in microscopes. The specimen should be such that the worms can be distinctly seen in the cyst, so that the learner may be able to recognize it without possibility of mistake or doubt. Writers on this subject describe several objects which may be mistaken for trichinæ, but for our purposes they are of no consequence whatever. If, after proper preparation, no *worms* can be seen, it does not matter what dark or oval specks we may find.*

Let us suppose, now, that we have a suitable microscope at our command, and that we wish to examine a piece of flesh for the purpose of determining if trichinæ be present. If we have the whole animal at our command, the parts that should be selected as being the most likely to harbor this parasite are the diaphragm, the tenderloin, and the muscles about the head and throat. In a ham the most likely place is that part at which the muscle ends in the tendon. From any of these parts take a very thin slice, lengthwise of the fibre, with a very sharp knife, or, which is better still, a razor. Others use a pair of scissors, *curved on the flat*, as it is called. By means of such scissors, it is easy for the most inexperienced person to cut a piece which shall taper off to a very thin edge. Where the operator has plenty of time at command, this thin section

*This must be taken, however, as applying only to cases in which the number of such objects is comparatively small. M. Megnin, in a paper read before the Society de Biologie, points out that many minute encysted worms are met with which are not trichinæ, although so closely resembling them as to have deceived many observers. The supposed discovery of trichinæ in the rootlets of beet-root, proved by Virchow and Kuhn to be a mistake, is a striking instance of this sort. Langenbeck described trichinæ in the intestines of earth worms, but Kuhn showed that the parasite is quite distinct from the *trichina spiralis*. Merlan and Tigri thought they had found trichinæ in the lungs of sheep, but Delpech showed that these were merely the embryos of *strongylus filaria*. Cobbold has stated that the trichinæ is common in the hedgehog. Megnin is convinced that this is an error, and that the worms described are merely the encysted larvæ of the *spiroptera clausa*. He showed preparations of an encysted nematoid worm, which might easily be mistaken for the trichina, but pointed out that the former differs in having a papilla at its mouth, and the anus is not terminal. Siebold described as a trichina a worm found in cysts in the peritoneum of the grey lizard and other creatures, but Megnin asserts that this also is the larva of a spiroptera (*S. abbreviata*), the adult individuals of which are abundant in the intestines of the same animal. An encysted spiroptera still more strikingly resembling the trichina has been found in the muscles of the frog. Very similar, but larger, encysted worms of the same genus have also been discovered in the subcutaneous tissues of a bird, the *Manchetes pugnax*. It will in general be found, however, that these parasites exist in the flesh in but small numbers.

may be soaked for some minutes in acetic acid. After a lapse of five to ten minutes, place the flesh on a slip of glass, spread it out as much as possible, and cover it with another piece of glass, which should be quite thin. The two slips of glass are then pressed closely together and placed on the stage of the microscope. Those who are provided with one of those well-known compressoriums, in which the two plates of glass are forced together by means of a lever and a screw, will find this little piece of apparatus just the thing for the purpose.

To those who are not provided with a microscope, or who wish to procure a cheap apparatus, combining both microscope and

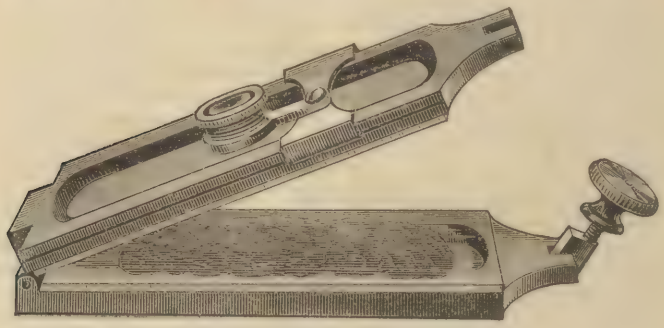


Fig. 6.

compressorium, we would recommend the trichinoscope, recently brought out by the Bausch & Lomb Optical Company, of Rochester, N. Y., and shown in the accompanying engravings. The instrument is made of two forms, of which Figures 6 and 9 give a clear idea. In Figure 6 the plates of glass between which the flesh is compressed are the ordinary glass slips (3 inches by 1 inch) used by microscopists. In the other form the glass plates are round discs.

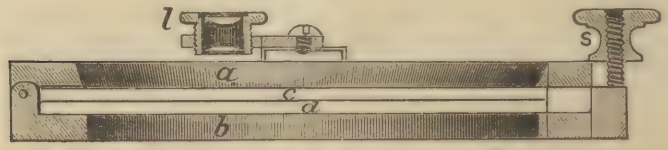


Fig. 7.

Otherwise the instruments are similar in all respects, and therefore we shall confine our description to that shown in Figs. 6, 7 and 8.

Here we have two metal plates hinged together at one end, and so arranged that they may be powerfully forced together by means of the screw at the other end. In the section, Fig. 7, *a* and *b* are the metal plates, out of the centre of which a large space has been cut,

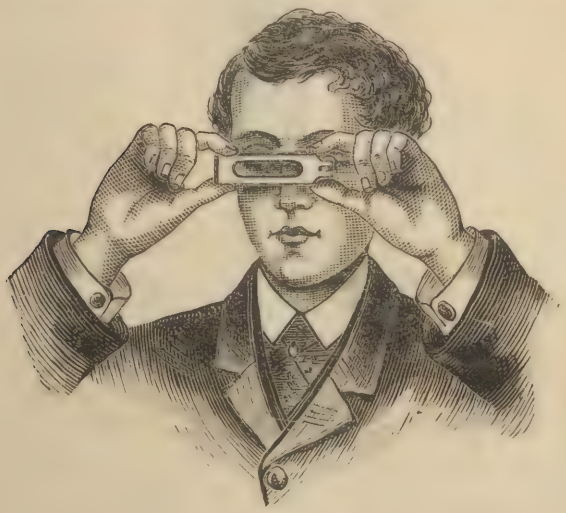


Fig. 8.

so as to permit the observer to look through the glass plates, *c* and *d*. The screw, *s*, serves to force the plates together, and the microscope, *l*, may be moved from end to end and also across the plates, so as to command a view of every part. The microscope is adjusted for focus by being screwed up or down in the socket at the end of the arm which carries it.

When desired, a compound microscope may be used in connection with the plates, as shown in Fig. 9, instead of the doublet shown in Fig. 7. Our own preference is for a doublet.

The method of using the instrument is very simple. A thin slice of flesh having been moistened with a mixture of equal parts of

acetic acid* and glycerine is placed on the lower plate and spread by means of needles, fixed in wooden handles, or by means of a

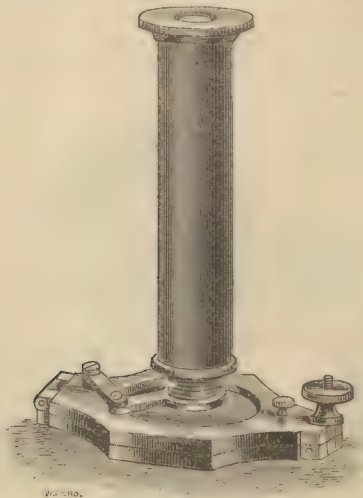


Fig. 9.

camel-hair pencil or brush. The upper plate is then brought down upon the lower one, and the screw is turned into the slot in which it fits. By turning the nut, *s*, Fig. 7, any degree of pressure may be brought to bear on the flesh, which may thus be rendered so thin and transparent that any trichinæ present will be readily visible. We have tried several of these instruments, and find them not only all that can be desired for this work, but so simple in their use that any butcher's boy can learn to use one.

With such appliances at command, and with the knowledge which we have of the life history of the trichina, it seems to us that there can no longer be any excuse for a case of trichinosis in the human subject, and very stringent enactments should be passed looking to the utter stamping out of this pest.

*Great care must be taken to see that strong vinegar, containing vinegar eels (*anguilula aceti*), is not used. There are cases on record where these vinegar eels, derived from the liquid used to moisten the specimen, have been mistaken for trichinæ.

THE NEW TRICHINOSCOPE,

of which a description and engraving are given in this pamphlet, may be obtained from any dealer in microscopes, or directly from the Bausch & Lomb Optical Company, of Rochester, N. Y. Price, with doublet, $3.00.

FOURTH EDITION. Greatly Enlarged, with over 80 Illustrations in the Text and 6 full page Engravings, printed on Heavy Tint Paper. 1 Vol. 12mo., 240 pages. Neatly Bound in Cloth, Gilt Title. Price $1.00.

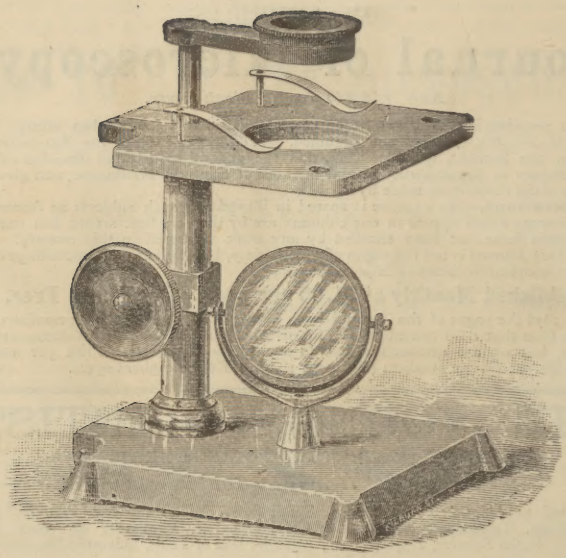
HOW TO USE THE MICROSCOPE.

A SIMPLE AND PRACTICAL BOOK, INTENDED FOR BEGINNERS.

By JOHN PHIN,

Editor of "The American Journal of Microscopy."

CONDENSED TABLE OF CONTENTS.



No. 400. *THE COMPACT DISSECTING AND MOUNTING MICROSCOPE.*

PATENTED AUG. 3, 1880.

The instrument above illustrated is the most Compact, Portable, and Efficient Microscope now in the market, and has the important feature, that, when folded, it is brought into a very small compass.

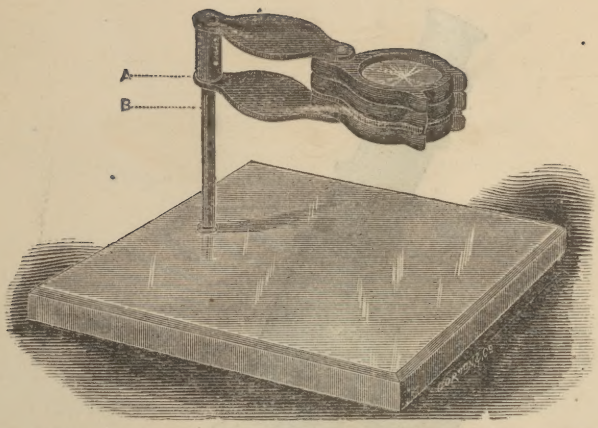
The cut represents the microscope arranged for use, and is about one-third actual size.

Two mounted lenses, respectively of 2 and 1 inch focus, and nickel-plated pliers accompany the instrument.

The whole packed in neat case, 6 inches by $4\frac{1}{2}$ inches, and $2\frac{1}{2}$ inches high, with receptacle for each part.

PRICE.

No. 400,	**$10 00**
" 410, same as No. 400, not folding,	**9 00**
Above arranged with hand rests, extra,	**2 00**



No. 327. THE HANDY DISSECTING MICROSCOPE.

The Dissecting Microscope represented in above cut is very efficient and convenient for examination of Minerals, Insects, Flowers, etc.

It consists of a glass plate, into which a steel stem is screwed, and the magnifiers arranged to slide on the stem. The magnifiers are furnished with one, two, or three lenses, which give a magnifying power of from 5—30 diameters. Those with two or three lenses are provided with a diaphragm, which secures distinctness of definition.

The stem can easily be unscrewed, and the whole packed in a small box. Extra stems of suitable length for lenses of short foci accompany the 2 and 3 lens magnifiers. Nickle-plated pliers are furnished with instruments.

The cut is two-thirds of actual size.

PRICES.

No. 325, with one lens, - - - - $1 00
" 326, with two lenses, - - - 1 25
" 327, with three lenses, - - - - 1 50
" 328, " " " short, plain finish, glass parts, without case, - - 1 00